Proposition 1E Stormwater Flood Management Grant Proposal

Lake Wohlford Dam Replacement Project

Attachment 7: Economic Analysis – Flood Damage Reduction Costs and Benefits

Attachment 7 consists of the following items:

- ✓ **Flood and Stormwater Background.** This attachment provides an overview of flood and stormwater management in the region and within the City of Escondido.
- ✓ **Project Costs.** The total costs associated with the project are presented.
- ✓ **Flood Damage Reduction Benefits.** The body of this attachment provides a description of the benefits of this proposed funding package with respect to potential flood damage reduction.

This attachment contains estimations of the flood damage reduction benefits, as well as the total costs associated with the *Lake Wohlford Dam Replacement Project.* Section 1 provides a summary of the regional flood control background with respect to the San Diego IRWM Region and the project area. Section 2 contains a narrative description of the expected costs that would be incurred to implement and operate the project over the project's lifetime (through 2060). Section 3 contains a narrative description of the expected flood damage reduction benefits of the *Lake Wohlford Dam Replacement Project.* Where possible, each benefit was quantified and presented in physical or economic terms. In cases where quantitative analyses were not feasible, this attachment provides complimentary qualitative analyses. In addition, this attachment provides a description of economic factors that may affect or qualify the amount of economic benefits to be realized. This attachment also includes a discussion regarding uncertainties about the future that might affect the level of benefit received.

Flood and Stormwater Background

Flood Control

The San Diego County Flood Control District (Flood Control District) is the primary flood control agency in the County of San Diego. The Flood Control District (which is governed by the elected Supervisors of the County) establishes flood policies, maintains flood control facilities, operates a regional flood warning system, and is charged with protection of watercourses, watershed management, and protection of water quality. On a project-by-project basis, the Flood Control District coordinates flood control actions among the County's municipalities, federal and state agencies, watershed management groups, and flood control organizations in Orange and Riverside counties. Each municipality within the region is responsible for designing, constructing, and maintaining necessary flood control structures within its jurisdiction. As such, the City of Escondido is responsible for flood control within its jurisdiction.

Stormwater Management

The San Diego County MS4 Permit (Order No. R9-2007-0001) regulates stormwater/urban runoff within the region. The County of San Diego acts as Principal Copermittee for the 21 Copermittees involved in this permit, which includes the City of Escondido. Each Copermittee is responsible for operating its own stormwater/urban runoff management program within its respective jurisdiction. The Copermittees are responsible for managing storm water quality and helping to implement the TMDLs established by the San Diego Regional Water Quality Control Board (RWQCB). The adopted San Diego IRWM Plan recognizes that it is important to protect surface and groundwater quality, which is reflected in Goal 2 of the IRWM Plan: *protect and enhance water quality.*

The City of Escondido's storm water program is implemented through the Utilities Department. The City's Jurisdictional Urban Runoff Management Plan outlines the responsibilities of various City departments in

reducing runoff pollution through a set of strategic pollution prevention measures. The City's Best Management Practices (BMP) Manual provides guidance for preventing urban runoff at the planning stages of new and redevelopment projects.

Project Costs

The following section provides information about all costs that will be incurred to implement, operate, and achieve benefits from the *Lake Wohlford Dam Replacement Project*. The summary of total project costs is based on Table 10 in DWR's Stormwater Flood Management Grant Proposal Solicitation Package.

Tables 7-1 and 7-2 below provide summary budgets for this grant proposal, demonstrating that the total project costs do not include any additional costs that are not included within the project budget (Attachment 4). The City of Escondido currently conducts ongoing operations and maintenance (O&M) for Lake Wohlford and the existing Lake Wohlford Dam, which includes daily inspections, telemetry readings, and erosion control. The City would continue to conduct these efforts with or without implementation of the *Lake Wohlford Dam Replacement Project.* Therefore, these costs are not considered necessary to accrue the benefits associated with this project, and were not included within the tables below.

Table 7-1: Total Project Costs – Summary

Phase	Timeline	Cost
Lake Wohlford Dam Replacement Project Capital Costs[1]	2009-2016	$30,698,100
Total Present Value of Discounted Costs (in $2009)		**$23,491,081**

Notes: Please refer to Table 7-2 below for additional detail on calculation of present value.
1 O&M costs are incurred during management of the existing Lake Wohlford Dam; those existing O&M costs would continue and no new or additional O&M costs are anticipated from the proposed replacement.

Table 7-2 demonstrates that the initial costs of the project, which sums to $30,698,100, will be allocated from 2009 to 2016, with the majority of funding being spent between 2013 and 2015. This initial cost total is equivalent to that presented within the Budget (Attachment 4) and is consistent with the Schedule (Attachment 5) of this grant proposal.

Table 7-2: Total Project Costs

Table 10 - Annual Cost of Flood Damage Reduction Project (All costs in 2009 dollars)									
	Initial Costs	Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
Year	Grand Total Cost from Table 7	Admin	Operation[1]	Maintenance[1]	Replacement	Other	Total Costs (a)+…+(f)	Discount Factor	Discounted Costs (g) x (h)
2009	$959,620	$0	$0	$0	$0	$0	$959,620	1.00	$959,620
2010	$959,620	$0	$0	$0	$0	$0	$959,620	0.94	$905,302
2011	$1,109,620	$0	$0	$0	$0	$0	$1,109,620	0.89	$987,558
2012	$1,109,620	$0	$0	$0	$0	$0	$1,109,620	0.84	$931,658
2013	$7,776,287	$0	$0	$0	$0	$0	$7,776,287	0.79	$6,159,547
2014	$8,316,667	$0	$0	$0	$0	$0	$8,316,667	0.75	$6,214,697
2015	$9,316,667	$0	$0	$0	$0	$0	$9,316,667	0.70	$6,567,882
2016	$1,150,000	$0	$0	$0	$0	$0	$1,150,000	0.67	$764,816
2017-2060	$0	$0	$0	$0	$0	$0	$0	--	$0
Project Life	**$30,698,100**	**$0**	**$0**	**$0**	**$0**	**$0**	**$30,698,100**	**--**	**$23,491,081**
							Total Present Value of Discounted Costs (Sum of Column (i))		**23,491,081**

1 O&M costs are incurred during management of the existing Lake Wohlford Dam; those existing O&M costs would continue and no new or additional O&M costs are anticipated from the proposed replacement.

Flood Damage Reduction Benefits

The flood damage reduction benefits that are anticipated to result from implementation of the *Lake Wohlford Dam Replacement Project* are summarized below in Table 7-3, and the cost-benefit overview is summarized in Table 7-4. This project would result in monetized benefits due to avoided flood damages.

Table 7-3: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Avoided Flood Damages	Monetized	Local and Regional

Table 7-4: Benefit-Cost Analysis Overview

	Present Value ($2009)
Costs – Total Capital and O&M	$23,491,081
Monetizable Benefits	
Avoided Flood Damages	$14,129,660
Qualitative Benefits	**Qualitative Indicator***
N/A	N/A

*Magnitude of effect on net benefits
+/- (negligible or unknown); + (moderate positive); ++ (significant positive); - (moderate negative); -- (significant negative)

The "Without Project" Baseline

The without project baseline for this flood damage reduction analysis consists of existing conditions relating to Lake Wohlford and Lake Wohlford Dam. It has been determined that due to age and composition of Lake Wohlford Dam, moderate to large earthquakes would almost always be sufficient to trigger a structural strength loss (GEI 2007). Therefore, without replacement of Lake Wohlford Dam, a moderate to large earthquake on the neighboring Elsinore Fault would be assumed to result in complete failure of Lake Wohlford Dam.

Figure 7-1 below demonstrates the existing flood inundation zone. This zone represents the area that would be flooded if Lake Wohlford Dam were to fail at its full capacity of 6,500 AF.

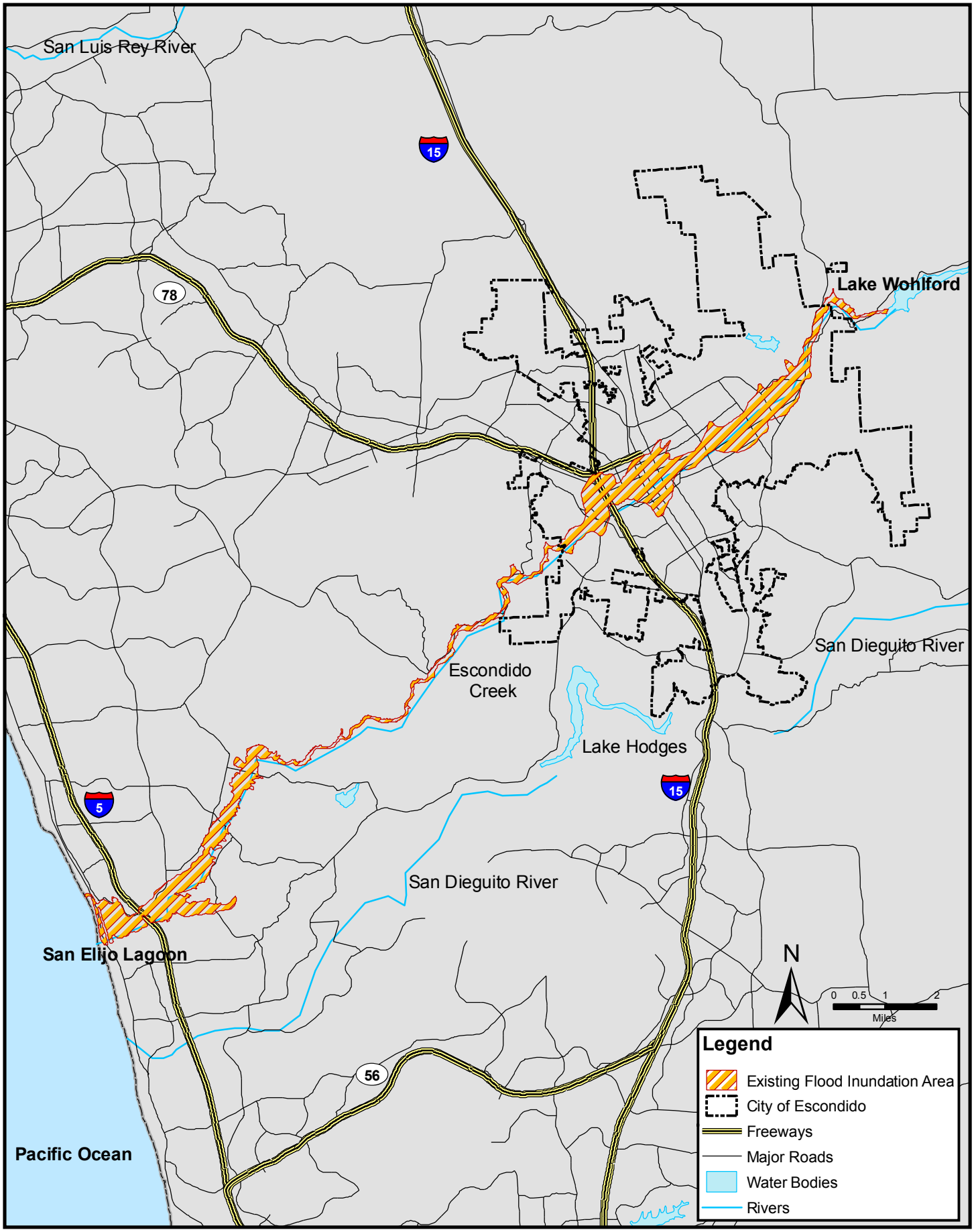
Benefits Analysis

Avoided Flood Damages

The primary objective of the *Lake Wohlford Dam Replacement Project* is to mitigate the potential for failure of the existing Lake Wohlford Dam due to seismic stability concerns. A liquefaction analysis performed in 2007 indicated that, "given the strain sensitivity of loose sand-like material, moderate to large earthquakes will almost always be sufficient to trigger a strength loss" (GEI 2007). This report analyzed seismicity resulting from the Elsinore Fault, which is located approximately 11.5 miles northeast of the existing Lake Wohlford Dam (refer to Figure 3-5 in Attachment 3). The maximum credible earthquake that could occur on the Elsinore Fault would be of a magnitude 7.5. An earthquake of this magnitude is considered to be large, and would therefore trigger a strength loss, or failure of the existing Lake Wohlford Dam. While a 7.5 is the largest earthquake that could occur on the Elsinore Fault, the liquefaction study notes that trigger events (dam failure events) can occur from earthquakes that are quite small (GEI 2007).

In 2008, the United States Geological Survey (USGS) in coordination with the California Geological Survey and the Southern California Earthquake Center produced an earthquake rupture forecast, which determined that the Elsinore Fault had an approximate 11 to 24% probability of producing a moderate to large earthquake (magnitude 6.7 or greater) over the next 30 years (Field et al 2008).

Figure 7-1: Existing Flood Inundation Area



In March 2010, the City of Escondido completed maps that demonstrated the inundation area that would be exposed to flooding if Lake Wohlford Dam were to fail for seismic reasons. This inundation area is presented in Figure 7-1 as the existing project condition. This inundation area was analyzed in ArcGIS in conjunction with 2009 land use data from the San Diego Association of Governments (SANDAG) (SANDAG 2009). This process demonstrated the area and parcels that would be inundated in the event of a seismic-related failure at Lake Wohlford Dam.

This analysis determined that 706 commercial units, 4,203 residential units, and 55 industrial units would be inundated if Lake Wohlford Dam were to fail. The land use data from SANDAG was reported in terms of parcels rather than units. This analysis used a conservative estimate of building density, and assumed one unit per parcel for all commercial land use categories with the exception of Community Shopping Centers and Neighborhood Shopping Centers. For the Community Shopping Centers and Neighborhood Shopping Centers designations, it was assumed that each parcel would have 15 commercial units. This assumption was based on SANDAG's Land Use Designations, which state that Neighborhood Shopping Centers include many small community commercial units that are not large enough to code separately and that Community Shopping Centers have 15 to 50 tenants (SANDAG 2007). Residential units in the category of Arterial Commercial, Mobile Home Park, Multi-Family Residential, Other Group Quarters, and Single Family Multiple-Units were assumed to have 12 units per parcel. This is based on the designation of Multi-Family Residential, which generally contains more than 12 units per acre (SANDAG 2007). Other residential units were conservatively assumed to have just one unit per parcel. All industrial uses were conservatively assumed to have one industrial unit per parcel.

The analysis described above was also performed for inundation of roads. Road inundation was determined based on the square feet of Freeway and Road Right-of-Way that would be inundated from failure of Lake Wohlford Dam. Data from SANDAG suggests that a freeway is at least 200 feet in width, while other roads were assumed to be 50 feet in width. These numbers were used in conjunction with standard feet to mile conversion ratios to estimate the miles of roads that would be inundated due to failure of Lake Wohlford Dam. These analyses determined that 8.17 miles of freeway and 134.57 miles of roads would be inundated.

This estimate of residential, commercial, industrial, and roadways located within the inundation area was input into the FRAM model, along with economic assumptions. Structural damage assumptions are outlined below in Table 7-5. The economic information input into FRAM, along with flood inundation data associated with Table 7-5, was determined from the National Flood Insurance Program (NFIP). NFIP states that over the past ten years, the average flood claim has amounted to over $33,000 (NFIP 2011). For purposes of this analysis, it was assumed that each structure that would be impacted would have an average flood damage cost of $33,000.

Table 7-5: Summary of Modeled Flood Damage

	Without Project	With Project
	Event: Magnitude 6.7 Earthquake on the Elsinore Fault	**Event: Magnitude 6.7 Earthquake on the Elsinore Fault**
Buildings		
Residential Structures Damaged	4,203	0
Commercial Structures Damaged	706	0
Industrial Structures Damaged	55	0
Roads		
Length of arterial (miles)	8.17	0
Length of major (miles)	134.57	0
Length of minor (miles)	0	0

To incorporate the probability of dam failure resulting from a large seismic event occurring on the Elsinore Fault, a coefficient of 0.008 (0.24/30) was input into the FRAM model in place of a proposed flood event. This value was determined based on the 2007 seismic study discussed previously, which determined that the Elsinore Fault had between an 11% and 24% chance of a major seismic event (at least 6.7 magnitude) occurring over the next 30 years. The higher 24% probability was used to capture probabilities associated with smaller earth quakes, because data from the City of Escondido suggests that even a smaller earthquake (less than 6.7) could potentially rupture Lake Wohlford Dam in its current condition.

Utilizing the assumptions discussed above, the FRAM model determined that the total expected annual damage from a seismic-related failure of the existing Lake Wohlford Dam would be $896,552. As per requirements set forth by DWR, this project is assumed to have a 50-year lifetime. Therefore, the present value coefficient utilized for these calculations was 15.76, which assumes a 50-year benefit period. The present value calculations related to anticipated flood damage benefits presented in Table 7-6 total approximately $14,129,660. Please note that these benefits have been measured through 2060, in accordance with DWR's Stormwater Flood Management Grant Proposal Solicitation Package. However, the newly constructed Lake Wohlford Dam is anticipated to accrue benefits over a longer lifetime, as this structure will likely remain in place for 100 years or more.

Table 7-6: Expected Annual Damage Benefits

Table 12 – Present Value of Expected Annual Damage Benefits			
(a)	Expected Annual Damage Without Project		$896,552
(b)	Expected Annual Damage With Project		$0
(c)	Expected Annual Damage Benefit	[a - b]	$896,552
(d)	Present Value Coefficient		15.76
(e)	**Present Value of Future Benefits**	**[c x d]**	**$14,129,660**

Distribution of Project Benefits and Identification of Beneficiaries

Table 7-7 summarizes the anticipated beneficiaries of flood damage reduction benefits that would be provided by the *Lake Wohlford Dam Replacement Project.* The flood damage reduction benefits would benefit local and regional residents within the existing flood inundation zone (refer to Figure 7-1).

Table 7-7: Project Beneficiaries Summary

Local	Regional	Statewide
Local residents within the existing flood inundation zone	Regional residents within the existing flood inundation zone	*Not Applicable*

Project Benefits Timeline Description

Flood reduction benefits would occur over the 50-year lifetime of the project and relative to the probability of a major seismic event occurring on the Elsinore Fault. Therefore, this project would accrue benefits due to a 0.008 annual probability of a major seismic event occurring.

Potential Adverse Effects from the Project

Any potential short-term construction-related impacts associated with this project would be addressed and mitigated during the environmental documentation and permitting processes. No long-term adverse effects are expected as a result of this project.

Uncertainty of Benefits

Uncertainties relating to the flood reduction benefits of this project are summarized below in Table 7-7. As shown in the table below, uncertainties regarding flood reduction benefits would occur because additional detailed flood modeling would demonstrate the full benefits of this project.

Table 7-7: Omissions, Biases, and Uncertainties and their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits	Comment
Avoided Flood Damages	+	Analysis utilized as part of this project, including the parcel data from SANDAG were notably conservative. As noted previously, assumptions were generally made that one unit would be damaged for every affected parcel. In reality it is much more likely that multiple units would be damaged for every parcel impacted by the flood inundation zone. Therefore, structural and road damage that would occur without this project would likely be much more extensive than calculated within this assessment. Further flood modeling could potentially find a moderate positive benefit for both structures and roads.

* Magnitude of effect on net benefits
+/- (negligible or unknown); + (moderate positive); ++ (significant positive); - (moderate negative); -- (significant negative)

References

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